Efficiency of the FeEDDS complex in the production of OH radicals

Belikov Yury A.,[1,2*] Snytnikova Olga A.,[1,3] Grivin Vyacheslav P.,[2] Pozdnyakov Ivan P.[1,2]

[1] *Novosibirsk State University, Pirogova 1, 630090, Novosibirsk, Russia*

[2] *Voevodsky Institute of Chemical Kinetics and Combustion SB RAS, Institutskaya 3, 630090, Novosibirsk, Russia*

[3] *International Tomography Center SB RAS, Institutskaya 3a, 630090, Novosibirsk, Russia*

* *E-mail: y.belikov@g.nsu.ru*

At present, the use of Fe(III) complexes with organic carboxylic acids in advanced oxidation processes (AOPs) aimed at wastewater treatment is being widely studied. The complexes show high quantum yields of photolysis along with a high efficiency of generation of reactive oxygen species, the main of which is the hydroxyl radical •OH under UV excitation. It is able to non-selective oxidation of a large number of organic pollutants.

As ligands in such complexes, both relatively simple acids (oxalic, puruvic, tartaric, etc.) and more complex ones, such as ethylenediamine-*N*,*N'*-disuccinic acid (EDDS), are studied. EDDS, being a structural isomer of ethylenediaminetetraacetic acid, is biodegradable in the environment, which allows it to be used for environmental purposes. However, for the practical application of the system, one needs information about the mechanism of photolysis and the quantum yields of ˙OH radicals (ϕ_{OH}). This work presents a detailed study of efficiency of both complex photolysis and ˙OH radicals generation in in a wide range of experimental conditions (pH, excitation wavelength, oxygen content, initial ligand and Fe(III) concentrations).

Using steady-state and laser flash photolysis methods in combination with spectrophotometry and liquid chromatography, we got the following results:

1. Primary intermediate is a long-lived (1.8 ms) radical complex [Fe(II)…EDDS•] (λ_{max} = 520 nm), which is formed by the electron transfer from ligand to Fe(III) ion.
2. The value of photolysis' quantum yield is stable in wide range of initial ligand and Fe(III) concentration, but depends on presence of oxygen. pH dependence also exists and it depends on presence of oxygen too. The value in optimal conditions achieves ~0.8.
3. ˙OH quantum yield is stable in wide range of initial ligand and Fe(III) concentration, but depends from pH and has achieved value ~0.15 in optimal conditions at neutral pH. High quantum yield make possible to use complex in AOPs.

Received results are important in understanding both fundamental photochemistry of Fe(III) polycarboxylate complexes and for application of such complexes in AOPs of wastewater treatment.

This work was financially supported by the Russian Science Foundation (No. 21-43-00004).